National Weather Service
Experimental NDFD CLIMATE
Product Description Document (PDD)

Part I – Mission Connection

A. Product Description- NDFDClimate is a computer application that creates images of forecast and climatological parameters for the continental U.S. from two different digital data sets. The first data set is the NDFD (National Digital Forecast Database) weather forecast grids produced by the NOAA National Weather Service (NWS) and the second data set is PRISM (Parameter-elevation Regressions on Independent Slopes Model), an expert system that uses point climatological temperature data and a digital elevation model (DEM) to generate gridded estimates of climate parameters. The NOAA National Weather Service (NWS) National Digital Forecast Database (NDFD) contains digital forecast grids of sensible weather elements such as temperature, wind, and precipitation in a mosaic from collaborating field offices across the U.S. for forecasts out to seven days. Daily digital climatology grids of maximum and minimum temperature are created using Parameter-elevation Regressions on Independent Slopes Model (PRISM; Daly et al. 1994) method. NDFDClimate grids produced include: PRISM derived normal daily maximum and minimum temperatures, NDFD derived forecasted heating and cooling degree days through day 6, NDFD forecasted daily minimum and maximum temperature anomalies derived from PRISM daily climate fields through day six, NDFD derived five day total of forecast heating and cooling degree days, NDFD 60 hour total of liquid equivalent QPF, NDFD forecasted number of hours the temperature is above or below a defined temperature through day three, NDFD forecasted 24- and 48-hour forecast temperature changes from forecast issue time.

B. Purpose- National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) is the official United States governmental voice for issuing warnings during life threatening weather situations. The mission also states "NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community." In order to complete its mission, the NWS relies on partnerships (e.g., the media and commercial weather companies) to distribute their observations, forecasts, and warning information. Technology and innovation have provided new information exchange pathways, including the Internet. NWS partners, as well as the general public, are becoming increasingly sophisticated and have new requirements for NWS' weather, water, and climate information. Users are demanding faster access to information that is

more accurate, easier to understand, and provided in new formats. NDFDClimate provides a new format for displaying climate data. NDFDClimate information can then be used to protect property from forecasted anomalous weather events.

C. Audience- The target audience for these experimental graphical products is the general public. The product will be available to the general public using the Internet.

D. Presentation Format - These images will be displayed on a web page (http://) with a table organized by the valid time (or month-day) of each forecast product listed in Table1. Animation loops are also available under 'loop' for most graphics. These images have contours and color fill that make the images easy to interpret. These images include the difference between the daily max and min temperature forecast and climatology, derived forecasts images from the NDFD grids, and current NDFD temperature and precipitation and forecasts images with enhanced color curves.

E. Feedback Method We are always seeking to improve our products based on user feedback. Comments regarding NDFDClimate forecast and climatology images should be sent to:

NOAA National Weather Service

ATTN: Christopher Mello

Federal Facilities Building Hopkins Airport

Cleveland, OH 44135

Or, e-mail the author at: Christopher.Mello@noaa.gov.

A link to a summary of comments is included on the web page.

Experimental feedback Period: December 15, 2005 through December 15, 2006

Part II Technical Description

a. Format and Science

PRISM is an expert system that uses point climatological temperature data and a digital elevation model (DEM) to generate gridded estimates of climate parameters (Daly et al. 1994). Temperature changes over flat terrain are easily estimated using linear interpolation between official National Climatic Data Center (NCDC) climate points. However, mountainous regions presented the biggest challenge in creating these climate grids due to the potential of great temperature changes over short horizontal distances. Fortunately, PRISM is well suited to mountainous regions.

PRISM recognizes that topography is an important climatic unit and elevation is a primary driver of many climate parameters. The PRISM system determines climate

element values at grid cells by calculating linear regression relationships between the climate element and elevation. Each grid cell estimate is determined from a separate multiple linear regression using data from Automated Surface Observing Systems (ASOS) locations, the nation's primary surface weather observing network and local national weather service mesonet stations. Data from each station in the multiple linear regressions is weighted based on five factors: distance, elevation, vertical layer, topographic facet, and coastal proximity. The horizontal resolution of PRISM data is 5 km across the continental U.S. Topographic facet, or topographic orientation, is primarily used for precipitation. Rain shadows and upslope enhancement are estimated using regression formulas based on wind flow divided into eight compass points and changes in elevation. Vertical layer refers to two layers: the boundary layer and the free atmosphere above the boundary layer. By separating into two layers, it became possible to identify temperature inversions in high mountain valleys also using regression.

Temperature data from PRISM consist of weekly averages of daily maximum and minimum temperature fields for the period 1971 to 2000. Interpolation between consecutive weekly data points was performed through a linear regression to obtain daily values throughout the year. It was assumed that the rate of change of daily high and low temperature during each week is constant.

Quality control was performed by comparing the derived daily normal maximum and minimum temperatures from NDFDClimate to the official data from the NCDC at 7 ER sites. All official NCDC daily normal maximum and minimum temperatures and daily NDFD maximum and minimum temperature forecasts are rounded to the nearest °F. Seven official climate sites in the Eastern Region were examined: Cleveland, OH; Toledo, OH; Erie, PA; Youngstown, OH, Syracuse, NY; Richmond, VA and Greenville, SC, and each site had a mean absolute error near 0.25 °F for both the normal daily maximum and minimum temperature. For all seven sites, the highest daily absolute error was less than 1°F for both the normal maximum and minimum temperature.

In addition to the images, a point and click feature is available using the same data sets discussed above using freely available graphical software GNU plot for selected cities. By clicking on a selected city, a new pop up image in a graphical format is launched. These images are NDFD High/Low Temperature forecasts along with a graph of normal high and low temperatures for the same date of the forecast. GNU plot produces network graphic products files (PNG).

All software included in NDFDClimate is free to download (see Mello and LaPlante 2005 for more information) and redistribute as long as no modifications to the source code are made.

b. Product Availability

The CLE WFO office located in Cleveland, Ohio will run NDFDClimate. The domain will include the entire Eastern Region of the NWS http://www.erh.noaa.gov/. The images

will be created at 10 past each hour and posted to the world wide web for public viewing. All images can be accessed through one web page. A link to the web page can be found on the Cleveland National Weather Service homepage at http://www.erh.noaa.gov/er/cle/.

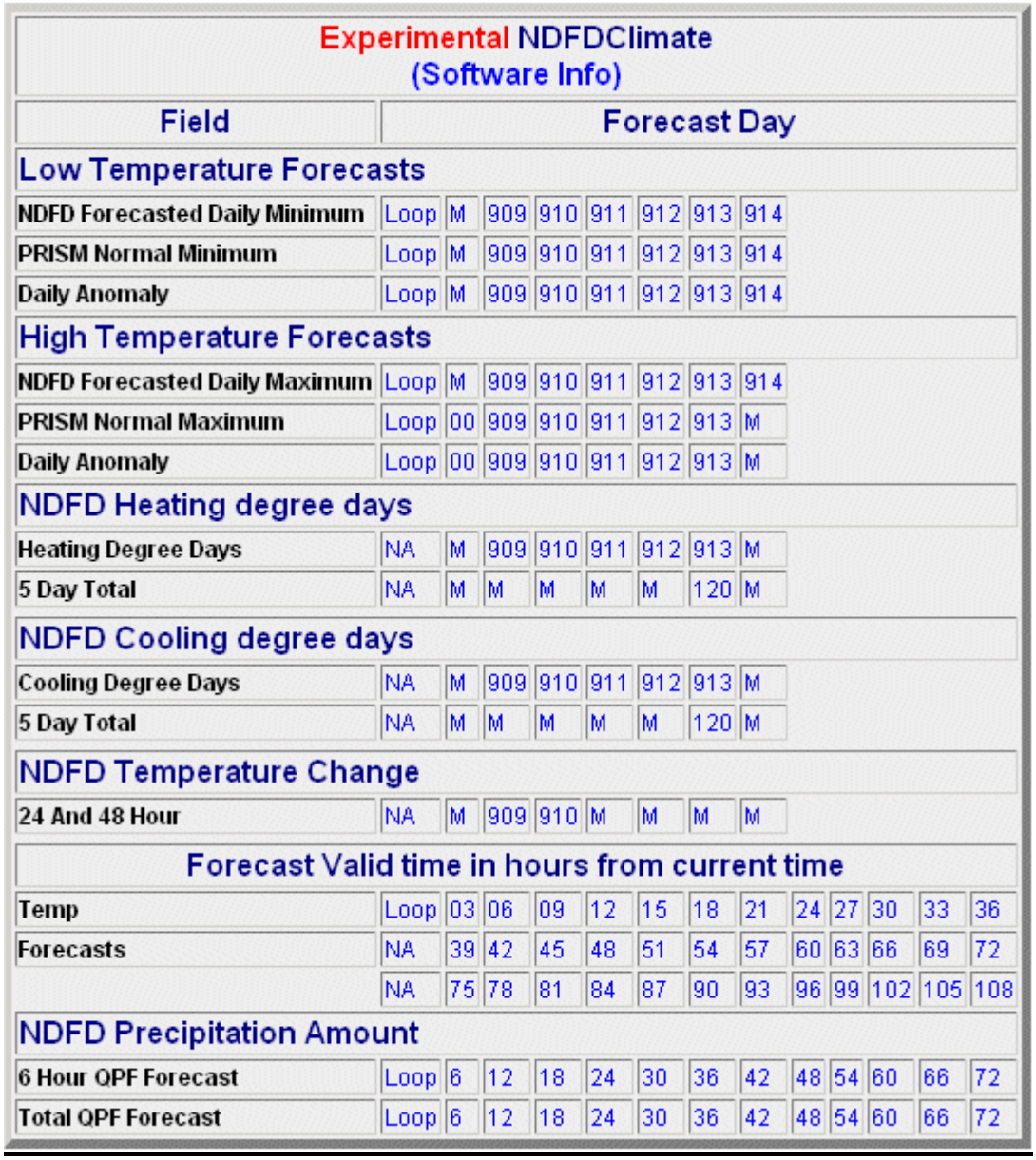
For NWS users, NDFDClimate should not be run on a computer inside the AWIPS firewall .

It takes about 10 minutes to run the software on a 2 GHz speed CPU.

(2) References

Daly, C., R.P. Neilson, and D.L. Phillips, 1994. A Statistical-Topographic Model for Mapping Climatological Precipitation over Mountainous Terrain. *J. Appl. Meteor.*, **33**, 140-158.

Mello, C. and R. LaPlante, 2005. NDFDClimate. NOAA/National Weather Service Eastern Region Technical Attachment, Bohemia, NY, 2005-04, pp.



Experimental NDFDClimate
(Software Info)

Field	Forecast Day												
Low Temperature Forecasts													
NDFD Forecasted Daily Minimum	Loop	M	909	910	911	912	913	914					
PRISM Normal Minimum	Loop	M	909	910	911	912	913	914					
Daily Anomaly	Loop	M	909	910	911	912	913	914					
High Temperature Forecasts													
NDFD Forecasted Daily Maximum	Loop	M	909	910	911	912	913	914					
PRISM Normal Maximum	Loop	00	909	910	911	912	913	M					
Daily Anomaly	Loop	00	909	910	911	912	913	M					
NDFD Heating degree days													
Heating Degree Days	NA	M	909	910	911	912	913	M					
5 Day Total	NA	M	M	M	M	M	120	M					
NDFD Cooling degree days													
Cooling Degree Days	NA	M	909	910	911	912	913	M					
5 Day Total	NA	M	M	M	M	M	120	M					
NDFD Temperature Change													
24 And 48 Hour	NA	M	909	910	M	M	M	M					
Forecast Valid time in hours from current time													
Temp	Loop	03	06	09	12	15	18	21	24	27	30	33	36
Forecasts	NA	39	42	45	48	51	54	57	60	63	66	69	72
	NA	75	78	81	84	87	90	93	96	99	102	105	108
NDFD Precipitation Amount													
6 Hour QPF Forecast	Loop	6	12	18	24	30	36	42	48	54	60	66	72
Total QPF Forecast	Loop	6	12	18	24	30	36	42	48	54	60	66	72

Figure 1. Sample NDFDClimate product table.

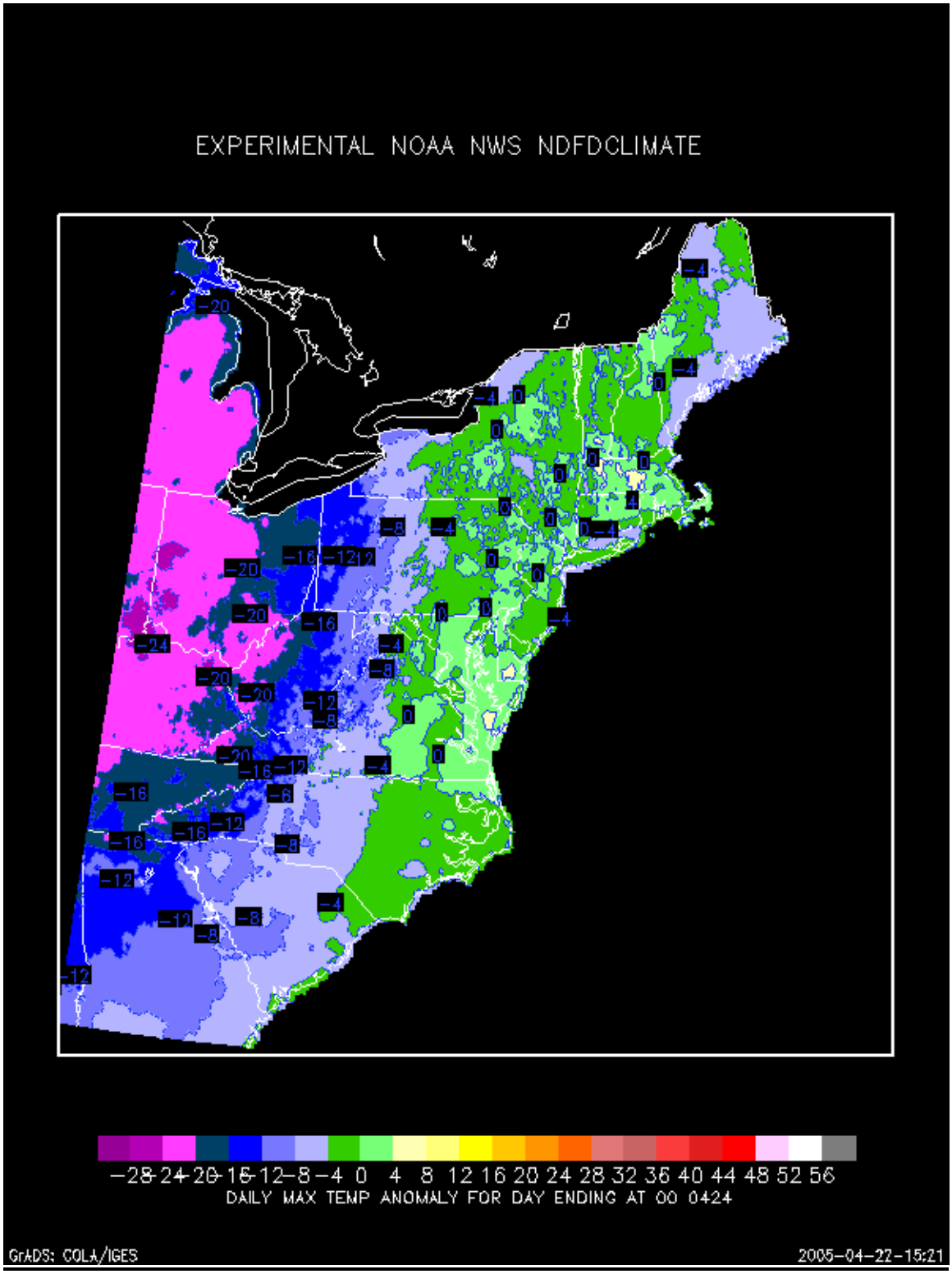


Figure 2. Daily maximum temperature anomaly (departure from normal in °F) ending 00 UTC 24 April 2005.

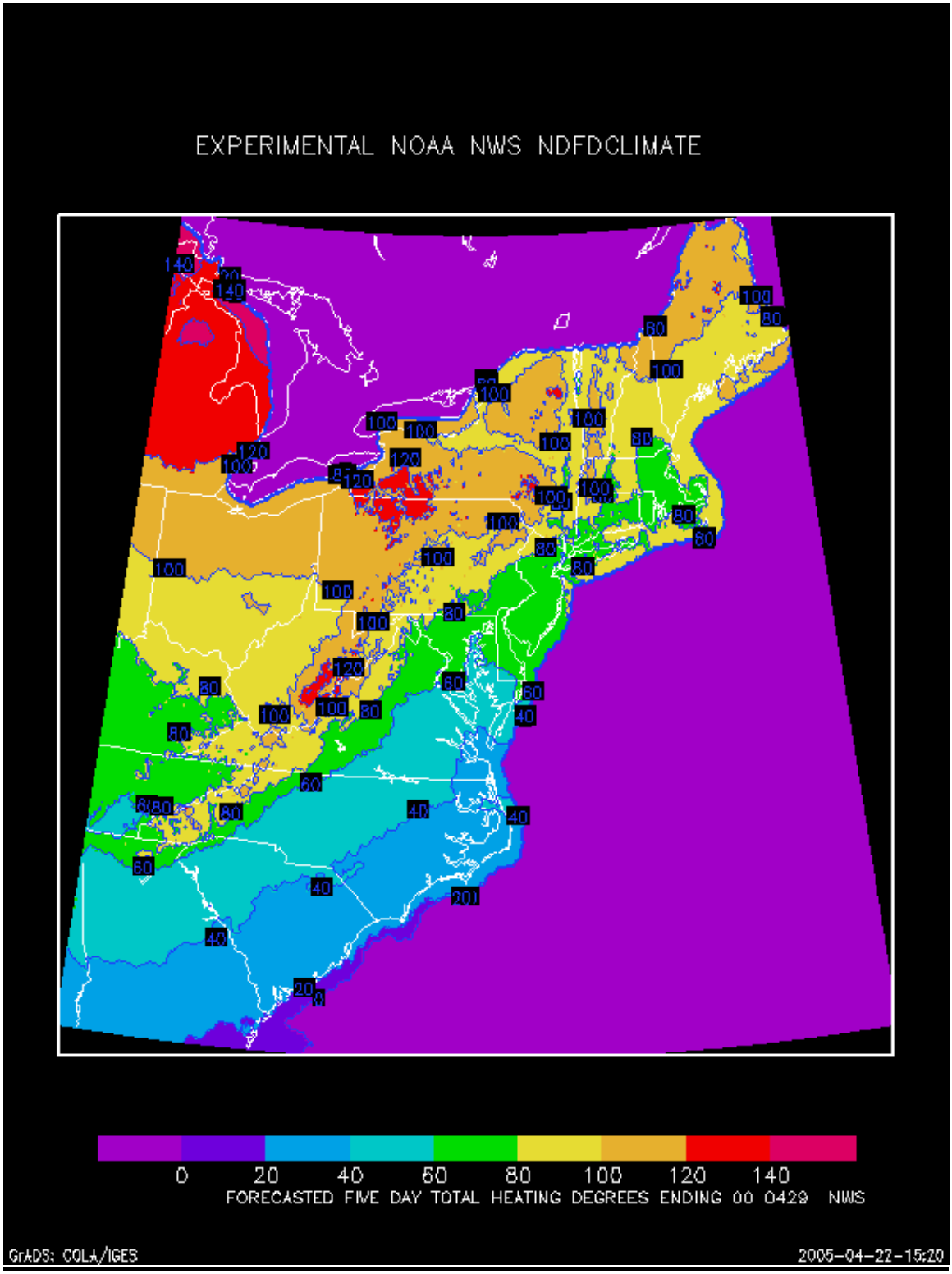


Figure 3. Forecast five day total heating degree days ending 00 UTC 29 April 2005.

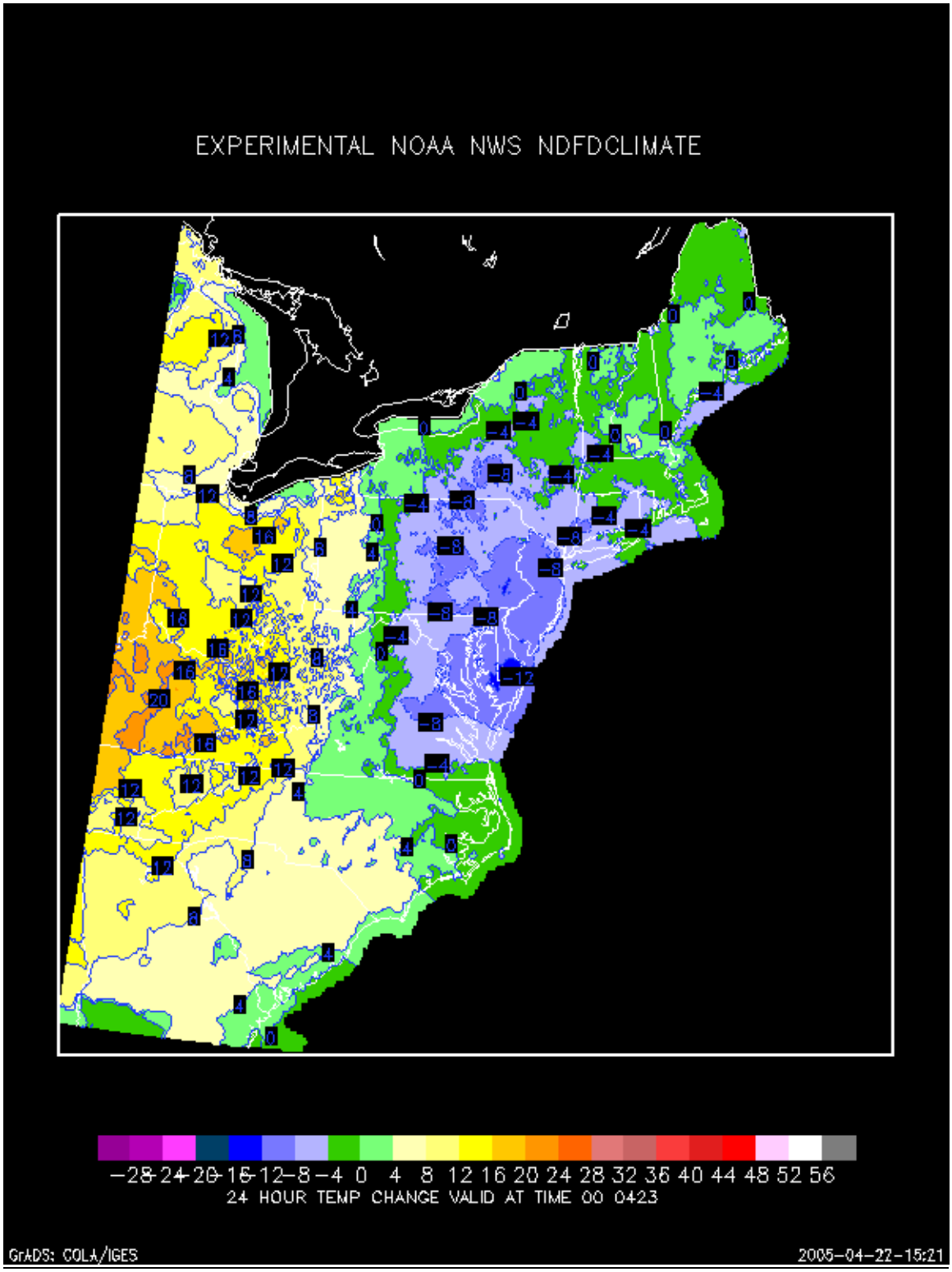


Figure 4. 24 hour temperature change (°F) valid at 00 UTC 23 April 2005.

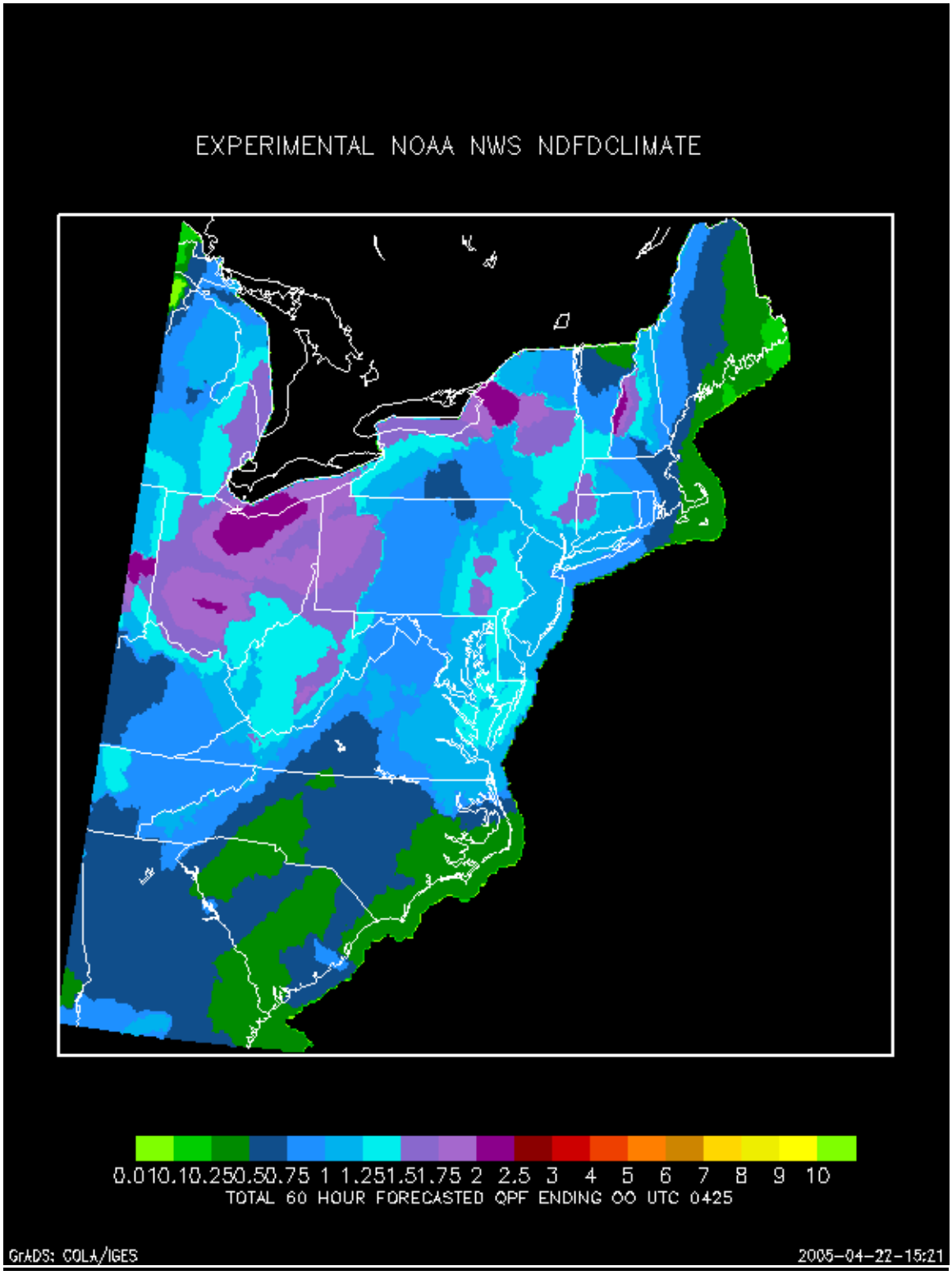


Figure 5. Total 60 hour QPF (in) ending at 00 UTC 25 April 2005.